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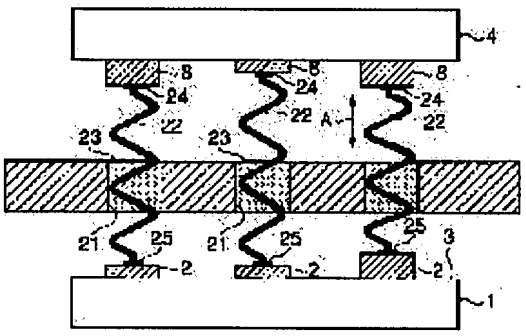
(54) ELECTRODE PROBER

(57)Abstract:

PROBLEM TO BE SOLVED: To maintain stable electric conduction property over a long term without losing a spring property.

SOLUTION: This electrode prober 19 is arranged between an tested IC package 4 having a plurality of electrodes 8 and an IC mounting face 3 in an IC test device testing an operation of the IC package for conduction between respective electrodes 2 on the IC mounting face in the IC test device with the respective electrodes 8 in the IC package 4. The electrode prober is provided with a plurality of expansible spring members 22, each of which is formed of a covalent crystal material, brought into contact with the electrode 2 on the IC mounting face 3 in one end, and brought into contact with the electrode 8 in the IC package 4 in the other end, conductive metallic coatings each covering the surface of each of the spring members, and a base board 20 supporting the intermediate positions of the respective spring members 22 without any contact mutually.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the electrode prober used for IC testing device.
[0002]
[Description of the Prior Art] For example, in IC testing device built into quality inspection Rhine of a semi-conductor plant, the performance test of each IC package in which IC (integrated circuit) which is the semi-conductor product by which sequential carrying in is carried out through this quality inspection Rhine was included is carried out in order. To IC included in this IC package, a power source is supplied or many electrodes for taking out the signal outputted from this IC are prepared [**** / impressing a signal] in the whole surface of an IC package to IC.
[0003] In IC testing device which carries out the performance test of this IC package, as shown in drawing 7 (a), IC attachment substrate 1 is incorporated and the IC clamp face 3 where two or more electrodes 2 were formed in the top face of this IC attachment substrate 1 is formed. This IC clamp face 3 is equipped with IC package 4 of a test objective. As shown in drawing 7 (b), the top face of this IC package 4 is energized in the IC attachment substrate 1 direction by the energization device 7 through putt 5 so that it may have ohmic contact with sufficient each electrode 8 of the inferior surface of tongue of IC package 4 and each electrode 2 of the IC clamp face 3 and may contact.
[0004] However, since direct soldering of each electrode 8 of IC package 4 and each electrode 2 of the IC clamp face 3 cannot be carried out, as shown in drawing 7 (b), it originates in the variation in the height of the electrode 8 of IC package 4, a clearance is generated an electrode 8 and between two, and there is concern which a faulty connection generates.
[0005] In order to cancel such un-arranging, he makes a sheet-like electrode prober intervene between each electrode 8 of IC package 4, and each electrode 2 of the IC clamp face 3, and is trying to make it flow through each electrode 8 of IC package 4, and each electrode 2 of the IC clamp face 3.
[0006] Drawing 8 is a cross section of the electrode prober 9 inserted between one electrode 2 of the IC clamp face 3 of IC testing device, and one electrode 8 of IC package 4. connection with the illustration cross-section configuration where the inferior surface of tongue was fixed to the electrode 2 of the IC clamp face 3 of a testing device -- India rubber 11 is enclosed in the conductor 10, the lower limit of a traveling contact 12 contacts this India rubber 11, and the upper limit of a traveling contact 12 contacts the electrode 8 of IC package 4. this traveling contact 12 -- connection -- it is prepared possible [sliding of the inside of the hole established in the conductor 10].
[0007] IC package 4 is pressed against this electrode prober 9 from the upper part so that the electrode 8 and traveling contact 12 of IC package 4 may contact. this time -- a traveling contact 12 -- connection -- it is pushed in along the inside of the hole established in the conductor 10, and a part for that migration is absorbed by deformation of India rubber 11. If IC package 4 is removed, since a traveling contact 12 is wide opened from the external force received from the electrode 8 of IC package 4 and India rubber 11 tends to return to the original form, a traveling contact 12 will also return to the original location.
[0008] In addition, in drawing 8 , although the example over the electrode 8 of 1 set of IC packages 4 and the electrode 2 of the IC clamp face 3 was shown, this electrode prober 9 can be used also to the combination of two or more electrodes 8.2. In this case, the variation in the height of the electrode 8 resulting from the magnitude of the electrode 8 of IC package 4 or the curvature of IC package 4 is absorbed with a movable

electrode 12, and can realize an electric flow to the combination of all the electrodes 2 and 8.
[0009] Drawing 9 is the cross section showing the outline configuration of other electrode prober 9a. the conductor formed in the location where this electrode prober 9a counters the insulation sheet 13 formed with the rubber ingredient, the electrode 8 of IC package 4 of this insulation sheet 13, and the electrode 2 of the IC clamp face 3 of IC testing device -- it is formed by the particle embedding part 14. this conductor -- the conductor embedded inside when the particle embedding part 14 was compressed -- particles -- contacting -- a conductor -- it flows through the top face and inferior surface of tongue of the particle embedding part 14.
[0010] therefore, this conductor -- before the particle embedding part 14 can apply **** rare ****** with the electrode 8 of IC package 4, and the electrode 2 of the IC clamp face 3 of IC testing device -- not necessarily -- a conductor -- particles do not touch. it is inserted with the electrode 8 of IC package 4, and the electrode 2 of the IC clamp face 3, and a pressure adds -- having -- a conductor -- if the insulation sheet 13 of the base material which is around a particle deforms -- a conductor -- particles contact electrically and an electric flow is realized between the electrode 8 of IC package 4, and the electrode 2 of the IC clamp face 3.
[0011] a conductor -- if the particle embedding part 14 is arranged according to the pattern of the electrode 8 of IC package 4, an electric flow will be obtained to two or more combination of the electrode 8 of IC package 4, and the electrode 2 of the IC clamp face 3. since [moreover,] insulation sheet 13 the very thing has elasticity -- a conductor -- the particle embedding part 14 can absorb the variation in the height direction of the electrode 8 of IC package 4 also in this electrode prober 9a like [it is possible to deform, when inserted with the electrode 8 of IC package 4 and the electrode 2 of the IC clamp face 3, and] the electrode prober 9 shown in drawing 8 .
[0012] Drawing 10 is the mimetic diagram showing the outline configuration of still more nearly another electrode prober 9b. the location which counters the electrode 8 of IC package 4 and the electrode 2 of the IC clamp face 3 of IC testing device in the insulating rod 15 formed by India rubber with a circular cross-section configuration and this insulating rod 15 was looped around this electrode prober 9b -- annular -- it consists of conductors 16.
[0013] and -- this -- annular -- a conductor 16 -- the electrode 8 of IC package 4, and the electrode 2 of the IC clamp face 3 -- ****** -- things realize an electric flow between the electrode 8 of IC package 4, and the electrode 2 of the IC clamp face 3. In this case, since the insulating rod 15 is formed by India rubber, to two or more combination of the electrode 8 of IC package 4 and the electrode 2 of the IC clamp face 3 with which height differs, it can absorb that height and can realize an electric flow to the total combination of the electrode 8 of IC package 4, and the electrode 2 of the IC clamp face 3.
[0014]
[Problem(s) to be Solved by the Invention] However, the following technical problems which should still be canceled also in each electrode probers 9.9a and 9b shown in drawing 8 , drawing 9 , and drawing 10 occurred.
[0015] namely, -- although variation with a height [in the electrode 8 of IC package 4] of dozens of micrometers or more is absorbable in the electrode prober 9 shown in drawing 8 -- connection -- since the inferior surface of tongue of a conductor 10 will be fixed to the IC clamp face 3 of IC attachment substrate 1 in IC testing device with solder, there is a problem that IC attachment substrate 1 cannot be exchanged independently.
[0016] Moreover, in electrode prober 9a shown in drawing 9 , since the insulation sheet 13 formed with the thin rubber ingredient is used and the spring nature which an insulation sheet 13 has is small, the variation in the height of the electrode 8 of IC package 4 dozens of micrometers or more is unabsorbable. Moreover, use of a repeat cannot be borne in order to deform plastically, if it is going to acquire big deformation. therefore, each electrode 8 of IC package 4 which has the variation beyond it -- a conductor -- it is difficult to contact the particle embedding part 14.
[0017] Since the insulating rod 15 which absorbs the variation in the height of the electrode 8 of IC package 4 is constituted from a rubber ingredient, degradation of a spring material progresses quickly with the increment in the use count, and it will stop moreover, having returned to the original configuration after deformation in electrode prober 9b shown in drawing 10 . as a result, it becomes impossible to have absorbed the variation in the height of the electrode 8 of IC package 4, and was looped around the insulating rod 15 into the electrode 8 of IC package 4 -- annular -- there was concern which the electrode 8 which cannot contact a conductor 16 generates.
[0018] This invention is made in view of such a situation, the electric flow between each electrode of an IC

package and each electrode of IC clamp face of IC testing device can be secured, without losing spring nature, without deforming plastically also to semipermanent use by choosing the spring ingredient which absorbs the variation in the height of the electrode of an IC package, and it aims at offering the electrode prober which can maintain the contact property continued and stabilized at the long period of time.

[0019]

[Means for Solving the Problem] This invention is inserted between the IC package of the test objective in which two or more electrodes were formed, and IC clamp face of IC testing device which performs the performance test of this IC package, and is applied to the electrode prober which makes it flow through each electrode of IC clamp face of IC testing device, and each electrode of an IC package.

[0020] And in order to cancel the above-mentioned technical problem, the electrode prober of this invention is equipped with the substrate which supports mutually the halfway location of two or more spring members which an end can expand and contract [which were formed with the covalent-bond nature crystal ingredient while the other end contacted the electrode of an IC package in contact with the electrode of IC clamp face], and each spring member [in / for the front face of each of this spring member / the metallic film of wrap conductivity, and two or more spring members] by non-contact.

[0021] Thus, in the constituted electrode prober, each electrode of an IC package flows electrically through the spring member of dedication in the electrode which counters the self in IC clamp face of IC testing device, respectively.

[0022] Furthermore, each spring member consists of covalent-bond nature crystal ingredients. It has the property of plastic deformation being unable to carry out this covalent-bond nature crystal ingredient easily even if the big amount of displacement is impressed, and being hard to deteriorate in ingredient also to repetition compressive stress.

[0023] Therefore, while the variation in the height of the electrode of an IC package is absorbable enough, it continues, and it is stabilized and the electric flow between each electrode of an IC package and each electrode of IC clamp face of IC testing device can be secured at a long period of time.

[0024] Moreover, in the electrode prober of invention which mentioned another invention above, after it penetrated each spring member to the through tube drilled by the substrate and each of this spring member has penetrated to each through tube, each of this through tube is filled up with adhesives.

[0025] Furthermore, in the electrode prober of invention which mentioned another invention above, the contact section which contacts the point which contacts each electrode of each spring member above each electrode and fixed area is formed. Thus, a better contact condition is maintainable between each electrode by forming the contact section in the point which contacts each electrode of each spring member.

[0026] Furthermore, in the electrode prober of invention which mentioned another invention above, each spring member is formed possible [telescopic motion] in one field. By adopting the spring member of such a configuration, a spring member can be easily created from a tabular covalent-bond nature crystal ingredient.

[0027] Furthermore, in the electrode prober of invention which mentioned another invention above, while each spring member is mutually parallel in one field, it consists of unit spring members of the really been [in the location which contacts each electrode / open for free passage] formed pair.

[0028] Thus, the stability of a spring member improves by constituting a spring member from a unit spring member of a pair.

[0029] Furthermore, in the electrode prober of another invention, the covalent-bond nature crystal ingredient is formed with single crystal silicon. Furthermore, polyimide, a ceramic substrate, etc. were adopted as the ingredient of a substrate, and gold, nickel, etc. are adopted as the ingredient of a conductive metallic film. This is because a ceramic substrate may be adopted as a substrate ingredient, when the sheet itself does not need to deform.

[0030]

[Embodiment of the Invention] Hereafter, each operation gestalt of this invention is explained using a drawing. Drawing 2 (a) is the perspective view showing the outline configuration of the electrode prober 19 concerning the 1st operation gestalt of this invention. (The 1st operation gestalt) Drawing 2 (b) is the sectional side elevation showing the condition of having equipped with the electrode prober 19 of this 1st operation gestalt between each electrode 2 of the IC clamp face 3 of IC attachment substrate 1 and each electrode 8 of IC package 4 of a test objective in IC testing device. Drawing 1 is the transverse-plane sectional view showing the

condition of having equipped IC testing device with this electrode prober 19.
[0031] In this electrode prober 19, the substrate 20 with a somewhat larger rectangle configuration than IC package 4 of a test objective with a rectangle configuration is formed with the polyimide which is the ingredient excellent in insulation. The thickness of a substrate 20 is very as thin as 50 micrometers - 100 micrometers. The through tube 21 which has a rectangle cross section is drilled in the location which counters each electrode 2 of the IC clamp face 3 of IC testing device, and each electrode 8 of IC package 4 by the substrate 20. In IC package 4 of this operation gestalt, since a total of six electrodes 8 is formed [two trains], the through tube 21 of a substrate 20 is drilled [six pieces and two trains] similarly. The magnitude of one side of each of this through tube 21 is 50 micrometers - 100 micrometers.
[0032] The spring member 22 has penetrated in each through tube 21 formed in the substrate 20. From the single crystal silicon wafer ingredient 26 which has die length of L= 100 micrometers - 200 micrometers, and the thickness of t= 10 micrometers - 20 micrometers as shown in drawing 3 (a), this spring member 22 is started by the etching technique in width of face of W= 100 micrometers, and a sinusoidal configuration with a thickness of t= 10 micrometers - 20 micrometers, as shown in drawing 3 (b).
[0033] Therefore, this spring member 22 is expanded and contracted only in the direction of drawing Nakaya mark A in one field which is parallel to the front face of the single crystal silicon wafer ingredient 26. And the contact sections 24 and 25 which contact above the electrode 8 of IC package 4 and the electrode 2 of the IC clamp face 3, and fixed area, respectively are formed in the point of this spring member 22.
[0034] The front face of the spring member 22 formed with this single crystal silicon is covered with the conductive metal coat which consists of gold (Au). In addition, a conductive metal coat will come off from the front face of the spring member 22, and the conductive metal coat which consists of gold (Au) will not fall, even if the spring member 22 expands and contracts greatly in the direction of arrow-head A, since it fully has elasticity as compared with single crystal silicon.
[0035] Where the center section of the direction of die-length L of the spring member 22 covered with the conductive metal coat is located in each through tube 21 formed in the substrate 20, it is filled up with the adhesives 23 of thermosetting or UV (ultraviolet rays) hardenability in each of this through tube 21, and each spring member 22 is fixed to a substrate 20 in it.
[0036] Next, the operation and the description of the electrode prober 19 of the 1st operation gestalt which were constituted in this way are explained. As shown in drawing 1 , it equips on the IC clamp face 3 of IC attachment substrate 1 in IC testing device so that the contact section 25 of each spring member 22 bottom may contact each electrode 2 of the IC clamp face 3. Next, it equips with each electrode 8 of IC package 4 of a test objective so that the contact section 24 of each spring member 22 top of the electrode prober 19 may be contacted. It equips on the electrode prober 19 in fact using the wearing equipment of dedication of IC package 4 by which sequential carrying in is carried out from quality inspection Rhine, and IC package 4 is energized to the method of drawing Nakashita using the energization device 7 explained by drawing 7 (a) and (b).
[0037] if IC package 4 is energized below, each electrode 8 of IC package 4 overcomes the spring repulsive force of the spring member 22, and moves below, and to each contact section 24 of the spring member 22, each electrode 8 will have the contact pressure of about 1 law, and will contact. The contact section 25 of each spring member 22 bottom of the electrode prober 19 also has almost fixed contact pressure, and contacts each electrode 2 of the IC clamp face 3. In this case, the variation in the height of the electrode 8 of IC package 4 is absorbable enough in flexible actuation of the spring member 22.
[0038] Moreover, the single crystal silicon which is a kind of a covalent-bond nature crystal ingredient is adopted as an ingredient of the spring member 22. It has the property of being hard to deform this single crystal silicon plastically even if the big amount of variation is impressed, and being hard to deteriorate in ingredient also to repetition compressive stress. Therefore, as mentioned above, while the variation in the height of the electrode 8 of IC package 4 is absorbable enough, it continues, and it is stabilized and the electric flow between each electrode 8 of IC package 4 and each electrode 2 of the IC clamp face 3 of IC testing device can be secured at a long period of time.
[0039] Furthermore, as explained using drawing 3 (a) and (b), single crystal silicon is excellent in workability, and can secure close dimensional accuracy. Consequently, the electrode prober 19 for the performance tests of IC package 4 in which the electrode 8 of a large number like LSI was formed can also be manufactured easily.
[0040] Moreover, since the spring member 22 formed with single crystal silicon can be manufactured simply

and in large quantities by the etching technique from the single crystal silicon wafer ingredient 26 as shown in drawing 3 (a), about the electrode prober 19, it is a low price and mass production method becomes possible.
[0041] Furthermore, since the contact sections 24 and 25 which contact to each electrodes 8 and 2 above fixed area are formed at the tip of each spring member 22, even if it energizes IC package 4 to the method of drawing Nakashita using the energization device 7, it can prevent doing big damage to each electrodes 8 and 2. To ****, a good contact condition is maintainable between each spring member 22 and each electrodes 8 and 2.
[0042] Furthermore, like the conventional electrode prober 9 shown in drawing 8 , since it is not necessary to fix to the IC clamp face 3 of IC attachment substrate 1 in IC testing device, this electrode prober 19 can exchange IC attachment substrate 1 independently, and can improve the versatility of IC attachment substrate 1 and the electrode prober 19.
[0043] (The 2nd operation gestalt) Drawing 4 is the cross section taking out and showing a part of electrode prober 19a of the 2nd operation gestalt of this invention. The same sign is given to the same part as the electrode prober 19 of the 1st operation gestalt shown in drawing 1 . Therefore, detail explanation of the overlapping part is omitted.
[0044] Each spring member 30 by which clothing was carried out with the conductive metal which flows through each electrode 8 of IC package 4 and each electrode 2 of the IC clamp face 3 which are built into electrode prober 19a of this 2nd operation gestalt electrically consists of unit spring members 30a and 30b of the really been [in the location which contacts each electrodes 8 and 2 / open for free passage] formed pair while it is mutually parallel in one field. And the part which contacts each electrodes 8 and 2 is formed in the flat surface so that it may contact to each electrodes 8 and 2 above fixed area. Therefore, the part formed in this flat surface is equivalent to the contact section shown in drawing 1 and drawing 3 .
[0045] Moreover, the halfway location of the two unit springs members 30a and 30b is being fixed with adhesives 23 in the through tube 21 of the substrate 20 which each spring member 30 which consists of unit spring members 30a and 30b of this pair penetrates. In addition, the manufacture approach of each spring member 30 which consists of unit spring members 30a and 30b of this pair is started using the etching technique from the single crystal silicon wafer ingredient 26 like each spring member 22 of the electrode prober 19 of the 1st operation gestalt.
[0046] Thus, the stability in the field which is parallel to the space in drawing 4 for constituting each spring member 30 from unit spring members 30a and 30b of the really formed pair improves.
[0047] (Application) Drawing 5 is the mimetic diagram showing the application of the electrode prober 19 of the 1st operation gestalt. The width of face W of each spring members 22a and 22b which connect electrically each electrode 8 of IC package 4 and each electrode 2 of the IC clamp face 3 in this electrode prober 9 differs. Therefore, two or more kinds of electrode probers 9 from which the width of face W of each spring members 22a and 22b differs are prepared.
[0048] And suppose that one side of the two electrodes 8 of IC package 4 is grounded, and one side is grounded between two electrodes 2 of the IC clamp face 3. In drawing 5 , the spring member 22b side is the earth side, and the spring member 22a side is a signal side.
[0049] When performing the performance test of IC package 4, effect of an impedance Z to the touch-down of the signal line of IC package 4 cannot be disregarded. That is, it is necessary to adjust the value of an impedance Z, to plan impedance matching between the impedance Z of the signal edge of IC package 4, and the impedance Z of the signal edge of IC testing device, and to control reflection of the RF signal in the I/O edge of a signal as much as possible.
[0050] The impedance Z between spring member 22a by the side of a signal and spring member 22b of the earth side becomes settled in a mutual distance (clearance B) of the spring members 22a and 22b, the dielectric constant of air, the dielectric constant of a substrate 20, the dielectric constant of adhesives 23, etc.
[0051] Then, by changing the width of face W of each spring members 22a and 22b, the clearance B between the spring members 22a and 22b can be changed, and an impedance Z can be changed. Therefore, what is necessary is just to choose the electrode prober 9 in which the spring members 22a and 22b with the width of face W used as the impedance Z which can plan impedance matching in each signal edge were included. In addition, it is also possible to change not only the width of face W but the thickness direction, and to adjust an impedance.
[0052] The frequency dependence property (dotted line) of the reflection factor of the signal in each signal edge

in the condition of not carrying out impedance matching to drawing 6 , and the frequency dependence property (continuous line) of the reflection factor of the signal in each signal edge in the condition of having carried out impedance matching are shown.

[0053] In the condition of having carried out impedance matching, it was proved that the reflection factor of the signal in each signal edge could be reduced sharply so that he could understand also in this frequency dependence property. Thus, the performance test of IC package 4 of a test objective can be carried out in a higher precision by carrying out impedance matching.

[0054]

[Effect of the Invention] As explained above, by the electrode prober smell of this invention, the spring member which absorbs the variation in the height of the electrode of an IC package is adopted, and the covalent-bond nature crystal ingredient represented with single crystal silicon as an ingredient of this spring member is used. Therefore, the electric flow between each electrode of an IC package and each electrode of IC clamp face of IC testing device can be secured without losing spring nature without deforming plastically also to semipermanent use, and the contact property continued and stabilized at the long period of time can be maintained.

[Translation done.]